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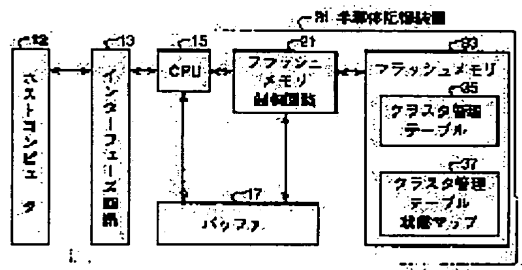
(54) SEMICONDUCTOR STORAGE DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To shorten start time at the time of starting the device and to reduce power consumption by referring to a table state map and converting a logical sector number into a physical sector number based on a value stored in a specified position of an address management table.
SOLUTION: In the case of reading out or writing data from/in a semiconductor storage device 31, a host computer 12 transmits a logical sector number to be the sector address of data requested to be processed to the device 31 through an interface circuit 13. In the device 31, a CPU 15 converts the logical sector number inputted through the circuit 13 into a physical sector number in a flash memory 33 by the use of a cluster management table 35 and a cluster management state map 37 stored in the memory 33 and reads out or writes data from/in an area specified by the physical sector number in the memory 33.



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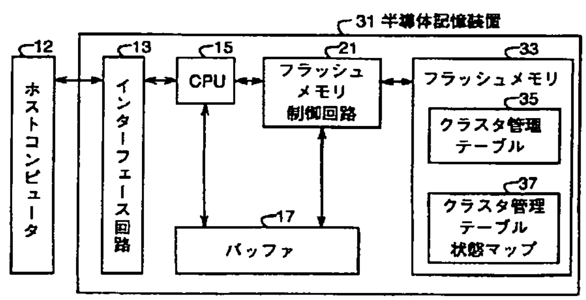
(54)【発明の名称】　半導体記憶装置

(57)【要約】

【課題】　起動時の立ち上がり時間を短縮し、また起動時の消費電力を抑さえた半導体記憶装置を提供する。

【解決手段】　接続されるホストコンピュータ12に対してデータの入出力を行うインターフェース回路13と、データを格納するフラッシュメモリ33と、半導体記憶装置31の制御を行うCPU15と、CPU15からの命令に基づきフラッシュメモリ33を制御するフラッシュメモリ制御回路21と、データを一時的に格納するバッファ17とを有する半導体記憶装置31において、ホストコンピュータ12から送信される論理クラスタ番号とフラッシュメモリ33内での物理クラスタ番号とを関連づけたクラスタ管理テーブル35と、クラスタ管理テーブル35が管理するデータのフラッシュメモリ33内の格納位置を管理するクラスタ管理テーブル状態マップ37とをフラッシュメモリ33内に備える。



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【特許請求の範囲】

【請求項１】　情報処理機器に接続され、フラッシュメモリからなりデータをセクタ単位で格納するメモリ部と、前記メモリ部に対してデータの書き込みまたは読み出し処理の制御を行う制御手段とを有する半導体記憶装置において、

前記情報処理機器がデータを管理するためのアドレスである論理セクタ番号と前記メモリ部内でデータを管理するためのアドレスである物理セクタ番号とを関連づけた情報を格納するアドレス管理テーブルと、

前記アドレス管理テーブル内の前記情報が格納される前記メモリ部内の物理的位置情報を格納するテーブル状態マップとを前記メモリ部内に設け、

前記制御手段は、前記情報処理機器からデータの読み出しまたは書き込みの要求があったときに、前記情報処理機器からの論理セクタ番号に基づいて、前記テーブル状態マップを参照して、前記論理セクタ番号の関連情報が格納される物理的位置を特定し、該特定された位置に格納される前記アドレス管理テーブルの値に基づき、前記論理セクタ番号を前記物理セクタ番号に変換することを特徴とする半導体記憶装置。

【請求項２】　情報処理機器に接続され、フラッシュメモリからなりデータをセクタ単位で格納するメモリ部と、前記メモリ部に対してデータの書き込みまたは読み出し処理の制御を行う制御手段とを有し、データを複数のセクタからなるクラスタ単位で管理する半導体記憶装置において、

前記情報処理機器がデータを管理するためのアドレスである論理セクタ番号に対応した論理クラスタ番号と前記メモリ手段内でデータを管理するためのアドレスである物理セクタ番号に対応した物理クラスタ番号とを関連づけた情報を格納するアドレス管理テーブルと、

前記アドレス管理テーブル内の前記情報が格納される前記メモリ部内の物理的位置情報を格納するテーブル状態マップとを前記メモリ部内に設け、

前記制御手段は、前記情報処理機器からデータの読み出しまたは書き込みの要求があったときに、前記情報処理機器からの論理セクタ番号に基づいて論理クラスタ番号とオフセットとを計算し、前記論理クラスタ番号に基づいて、前記テーブル状態マップを参照して、前記論理クラスタ番号の関連情報が格納される物理的位置を特定し、該特定された位置に格納される前記アドレス管理テーブルの値に基づき、前記論理クラスタタ番号を前記物理クラスタ番号に変換し、該変換された物理クラスタ番号と前記オフセットとから物理セクタ番号を求めることを特徴とする半導体記憶装置。

【請求項３】　請求項１または請求項２に記載の半導体記憶装置において、前記アドレス管理テーブルは１セクタの大きさを持つ少なくとも１つのテーブルから構成され、前記テーブル状態マップは前記アドレス管理テーブルを構成する前記テーブルを特定するためのテーブル番号と前記テーブルが格納される前記メモリ部内の物理セクタ番号とを関連づけた情報を格納することを特徴とする半導体記憶装置。

【請求項４】　請求項１または請求項２に記載の半導体記憶装置において、前記セクタの大きさは前記フラッシュメモリ内のデータの消去または書き込み単位である消去ブロックの大きさと等しいことを特徴とする半導体記憶装置。

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【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、所定の単位毎にデータの消去が可能なフラッシュメモリ等のブロック消去型不揮発メモリを搭載した半導体記憶装置に関するものである。

【０００２】

【従来の技術】携帯型コンピュータやデジタルスチルカメラ等の携帯型の情報処理機器の普及に伴い、駆動系を持たないフラッシュメモリ（電気的に書き込みおよび消去が可能な不揮発性メモリ）を用いた小型の半導体記憶装置が普及しつつある。通常、フラッシュメモリを用いた半導体記憶装置と情報処理機器（以下、「ホストコンピュータ」と称す。）とは５１２バイト単位でデータ転送が行われる。また、半導体記憶装置に搭載されるフラッシュメモリにおいては、データの消去は所定のデータ単位である消去ブロック単位で行われる。この消去ブロックの大きさは数Ｋバイトから数十Ｋバイトであり、前述のデータ転送の単位（５１２バイト）に比べるとかなり大きい値となる。

【０００３】フラッシュメモリ内のデータを書き換える時は、そのデータが含まれる消去ブロック全体を書き換える必要がある。例えば、５１２バイトのデータを書き換える場合では、その５１２バイトのデータが含まれる数Ｋバイトから数十Ｋバイトの消去ブロック内のデータを一旦別の領域に退避させ、そのブロックを消去した後、そのブロックに退避させたデータとともに新しいデータを書き込む必要がある。このため、書き込み効率が悪いという問題があった。また、フラッシュメモリにおいては、消去回数に上限があるため、各ブロックの消去回数をある程度均一にしながらデータの消去・書き込みを行う必要があった。

【０００４】このような問題を解決するために、例えば、特開平５－２７９２４号公報に開示されたアドレス変換テーブルを備えた半導体記憶装置がある。図８に、このアドレス変換テーブルを備えた半導体記憶装置のブロック図を示す。図に示すように、半導体記憶装置１１は、ホストコンピュータ１２との間でデータのやりとりを行うインターフェース回路１３と、半導体記憶装置１１全体を制御するＣＰＵ１５と、ホストコンピュータ１２から要求されたデータを処理する間、データを一時的

に格納するバッファ１７と、ホストコンピュータ１２から送信される論理セクタアドレス（論理セクタ番号）とフラッシュメモリ内部の物理セクタアドレス（物理セクタ番号）とを対応づけるアドレス変換テーブルを格納するアドレス変換テーブルＲＡＭ１９と、データを記憶するフラッシュメモリ２３と、フラッシュメモリ２３を制御するフラッシュメモリ制御回路２１とからなる。アドレス変換テーブルＲＡＭ１９はＳＲＡＭ（スタティックＲＡＭ）やＤＲＡＭ（ダイナミックＲＡＭ）から構成されている。

【０００５】このような半導体記憶装置１１において、ＣＰＵ１５が半導体記憶装置１１内のデータを書き換える場合は、書き換えるデータを含む元の消去ブロックについては処理を行わず、フラッシュメモリ２３内の空き領域に元の消去ブロックのデータとともに新しいデータを書き込むとともに、新しい消去ブロックに対応させてアドレス変換テーブルを書き換える。以降、ＣＰＵ１５はこのアドレス変換テーブルを参照することにより、ホストコンピュータ１２からの論理セクタアドレスとフラッシュメモリ２３内の物理セクタアドレスとを対応づけることができ、フラッシュメモリ２３内のデータをアクセスすることができる。

【０００６】

【発明が解決しようとする課題】しかし、このようなアドレス変換テーブルＲＡＭ１９を用いた半導体記憶装置では、半導体記憶装置を起動時にフラッシュメモリ内のデータを全て検索することによりアドレス変換テーブルＲＡＭ１９においてアドレス変換テーブルの構築処理を行う必要がある。このため、アドレス変換テーブルの構築処理のための処理時間が必要となり、立ち上がりに時間がかかるという問題がある。また、このアドレス変換テーブル構築処理時の電力消費のため、電力供給能力の低いホストコンピュータ１２の場合、ホストコンピュータ１２がダウンするという問題がある。さらに、アドレス変換テーブルはセクタ単位で論理アドレスと物理アドレスを対応づけているため、半導体記憶装置の容量の増加に伴い、アドレス変換テーブルが大きくなり、アドレス変換テーブルを格納するアドレス変換テーブルＲＡＭ１９の容量も大きくする必要があり、半導体記憶装置全体のコストの増加につながる。

【０００７】本発明は、上記問題を解決すべくなされたものであり、その目的とするところは、起動時の立ち上がり時間を短縮し、また起動時の消費電力を抑さえた半導体記憶装置を提供することにある。

【０００８】

【課題を解決するための手段】本発明に係る第１半導体記憶装置は、情報処理機器に接続され、フラッシュメモリからなりデータをセクタ単位で格納するメモリ部と、前記メモリ部に対してデータの書き込みまたは読み出し処理の制御を行う制御手段とを有する半導体記憶装置において、前記情報処理機器がデータを管理するためのアドレスである論理セクタ番号と前記メモリ部内でデータを管理するためのアドレスである物理セクタ番号とを関連づけた情報を格納するアドレス管理テーブルと、前記アドレス管理テーブル内の前記情報が格納される前記メモリ部内の物理的位置情報を格納するテーブル状態マップとを前記メモリ部内に設ける。前記制御手段は、前記情報処理機器からデータの読み出しまたは書き込みの要求があったときに、前記情報処理機器からの論理セクタ番号に基づいて、前記テーブル状態マップを参照して、前記論理セクタ番号の関連情報が格納される物理的位置を特定し、該特定された位置に格納される前記アドレス管理テーブルの値に基づき、前記論理セクタ番号を前記物理セクタ番号に変換する。

【０００９】本発明に係る第２半導体記憶装置は、情報処理機器に接続され、フラッシュメモリからなりデータをセクタ単位で格納するメモリ部と、前記メモリ部に対してデータの書き込みまたは読み出し処理の制御を行う制御手段とを有し、データを複数のセクタからなるクラスタ単位で管理する半導体記憶装置において、前記情報処理機器がデータを管理するためのアドレスである論理セクタ番号に対応した論理クラスタ番号と前記メモリ部内でデータを管理するためのアドレスである物理セクタ番号に対応した物理クラスタ番号とを関連づけた情報を格納するアドレス管理テーブルと、前記アドレス管理テーブル内の前記情報が格納される前記メモリ部内の物理的位置情報を格納するテーブル状態マップとを前記メモリ手段内に設ける。前記制御手段は前記情報処理機器からデータの読み出しまたは書き込みの要求があったときに、前記情報処理機器からの論理セクタ番号に基づいて論理クラスタ番号とオフセットとを計算し、前記論理クラスタ番号に基づいて、前記テーブル状態マップを参照して、前記論理クラスタ番号の関連情報が格納される物理的位置を特定し、該特定された位置に格納される前記アドレス管理テーブルの値に基づき、前記論理クラスタ番号を前記物理クラスタ番号に変換し、該変換された物理クラスタ番号と前記オフセットとから物理セクタ番号を求める。

【００１０】本発明に係る第３半導体記憶装置は、上記第２半導体記憶装置において、前記アドレス管理テーブルが１セクタの大きさを持つ少なくとも１つのテーブルから構成される。また、前記テーブル状態マップが前記アドレス管理テーブルを構成する前記テーブルを特定するためのテーブル番号と前記テーブルが格納される前記メモリ部内の物理セクタ番号とを関連づけた情報を格納する。

【００１１】本発明に係る第４半導体記憶装置は、上記半導体記憶装置において、前記セクタの大きさを前記メモリ部内のデータの消去または書き込み単位である消去ブロックの大きさと等しくする。

【0012】

【発明の実施の形態】以下、添付の図面を参照して本発明に係る半導体記憶装置の実施の形態を説明する。図1は、本実施の形態の半導体記憶装置のブロック図を示す。尚、図1において、図8で示される従来の半導体記憶装置を構成する構成要素と同じものは同じ符号で示している。図1に示すように半導体記憶装置31は、インターフェース回路13と、CPU15と、バッファ17と、フラッシュメモリ制御回路21と、フラッシュメモリ33とから構成される。フラッシュメモリ33はクラスタ管理テーブル35とクラスタ管理テーブル状態マップ37とをさらに備える。また、半導体記憶装置31は情報処理機器であるホストコンピュータ12と接続され、ホストコンピュータ12に対してデータの入出力を行う。

【0013】半導体記憶装置31において、インターフェース回路13は半導体記憶装置31とホストコンピュータ12との間でデータの受け渡しを行う。フラッシュメモリ33はデータを記憶するものであり、電気的に消去可能な不揮発メモリから構成される。CPU15は半導体記憶装置31内部の制御を行う。フラッシュメモリ制御回路21はCPU15からの制御に基づいて、フラッシュメモリ33に対してデータの読み出しや書き込みを行う。この際、フラッシュメモリ制御回路21はバッファ17に一時的にデータを格納しながらフラッシュメモリ33に対するデータ処理を行う。このようにCPU15とフラッシュメモリ制御回路21とはフラッシュメモリ33を制御するための制御手段をなす。

【0014】ホストコンピュータ12は半導体記憶装置31に対してデータの読み出しまたは書き込みを行うときは、半導体記憶装置31に対してインターフェース回路13を介して、読み出しまたは書き込み等の処理を要求するデータのセクタアドレスである論理セクタ番号を送信する。半導体記憶装置31において、CPU15はインターフェース回路13を介して入力された論理セクタ番号をフラッシュメモリ33内のクラスタ管理テーブル35およびクラスタ管理テーブル状態マップ37を用いてフラッシュメモリ33内のセクタアドレスである物理セクタ番号に変換し、この物理セクタ番号で指定されるフラッシュメモリ33内の領域に対してデータの読み出しまたは書き込みを行う。

【0015】フラッシュメモリ33内のデータ領域は図2の（a）に示すように複数のセクタから構成される。本実施の形態においては、このセクタの大きさとフラッシュメモリ33内の書き込みまたは消去の単位である消去ブロックの大きさとを同じにしており、これによりデータの書き込みまたは消去をセクタ単位で行うことができる。図3に本実施の形態における消去ブロック（セクタ）の構成を示す。消去ブロックはデータ記憶領域41（512バイト）と消去ブロック状態記憶領域43と予備領域45とECC領域47とから構成される。そのサイズは512＋αバイト（αは例えば16バイト）とする。データ記憶領域41にはデータが格納され、消去ブロック状態記憶領域43にはその消去ブロックの消去回数や、消去や書き込みに要した時間等の消去ブロックの状態を示す情報が格納される。消去に要した時間はCPU15が内部タイマで測定し、データ書き込み時に記録する。CPU15はこれらの情報を参照して個々の消去ブロックの特性を確認することができる。例えばCPU15は個々の消去ブロックの消去や書き込みに要した時間を確認し、所定時間以上の時間を要しているものに関しては、不良と見なして、ブロックの代替等の処理を行うことができる。予備領域45は予備のために確保されている領域であり通常データは書き込まれていない。ECC領域47には消去ブロック毎にフラッシュメモリ制御回路21においてECC領域47を除く消去ブロックの領域に対して計算されたエラー訂正符号（ECC）が格納されている。

【0016】また、本実施の形態の半導体記憶装置31は図2の（b）に示すように4セクタを1クラスタとし、クラスタ単位でデータを管理する。すなわち、ホストコンピュータ12から送信される論理セクタ番号および、フラッシュメモリ33内の物理セクタ番号をそれぞれクラスタ単位で管理する。このようなクラスタ管理においては、セクタの位置はクラスタを指定するクラスタ番号とクラスタ内のオフセットとにより特定される。例えば、セクタ番号が6のセクタである「セクタ6」はクラスタ番号1のクラスタである「クラスタ1」と「オフセット2」によりその位置が特定される。そこで、本実施の形態では、クラスタ単位でのデータ管理を行うため、図1に示すようにクラスタ管理テーブル35およびクラスタ管理テーブル状態マップ37をフラッシュメモリ33内に設けている。以下、クラスタ管理テーブル35およびクラスタ管理テーブル状態マップ37について説明する。

【0017】クラスタ管理テーブル35は、ホストコンピュータ12から送信される論理クラスタ番号と、それに対応するフラッシュメモリ33内の物理クラスタ番号とを関連づけており、本実施の形態においてアドレス管理テーブル手段をなしている。CPU15はホストコンピュータ12から送信される論理セクタ番号をこのクラスタ管理テーブル35を用いて最終的にフラッシュメモリ33内の物理セクタ番号に変換する。このようにクラスタ管理テーブル35により物理セクタ番号と論理セクタ番号とが対応づけられることにより、フラッシュメモリ33内の不良セクタを含むクラスタの使用を回避することができる。

【0018】図4はクラスタ管理テーブル35の概念を示した図である。図4の（a）に示すように本実施の形態においては、クラスタ管理テーブル35は「テーブル

０」～「テーブル２５５」の２５６個のテーブルから構成される。１つのテーブルは１セクタすなわち５１２バイトの領域を有し、２５６個の論理クラスタ番号に対応した物理クラスタ番号を管理する。クラスタ管理テーブル３５全体としては、５１２バイト×２５６＝１２８Ｋバイトの領域を有する。各テーブル間で管理する論理クラスタ番号は連続しており、例えば、「テーブル０」は論理クラスタ番号が０～２５５の物理クラスタ番号を管理し、「テーブル１」は論理クラスタ番号が２５６～５１１の物理クラスタ番号を管理する。「テーブル０」～「テーブル２５５」の各テーブルは図４の（ｂ）に示すように２バイトの領域に、論理クラスタ番号に対応した物理クラスタ番号を順次格納している。したがって、クラスタ管理テーブル３５を構成するテーブルのテーブル番号とテーブル内のオフセットにより論理クラスタ番号に対応した物理クラスタ番号が特定できる。クラスタ管理テーブル３５もデータと同様、４セクタ（４テーブル）を１クラスタとしてクラスタ単位で管理される。

【００１９】次にクラスタ管理テーブル状態マップ３７について説明する。クラスタ管理テーブル状態マップ３７はクラスタ管理テーブル３５を構成するテーブルのフラッシュメモリ３３内の格納位置である物理クラスタ番号を管理するためのものである。すなわち、クラスタ管理テーブル３５を構成する各テーブルがフラッシュメモリ３３内のどこに存在するかを示すために用いられる。これにより、フラッシュメモリ３３内においてクラスタ管理テーブル３５を連続した領域に確保できない場合に、クラスタ管理テーブル３５を不連続な領域に割り当てることができる。図５にクラスタ管理テーブル状態マップ３７の構成を示す。

【００２０】図５の（ｂ）に示すように、クラスタ管理テーブル状態マップ３７は１セクタの領域からなり、クラスタ管理テーブル３５を構成するテーブルのテーブル番号とその番号のテーブルが格納されるクラスタの物理クラスタ番号とを対応づけて管理している。すなわち、クラスタ管理テーブル状態マップ３７の５１２バイトの領域において、先頭から２バイト毎にテーブルの領域を順次割当て、該当する領域にそのテーブルを格納するクラスタの物理クラスタ番号を格納している。ＣＰＵ１５はクラスタ管理テーブル状態マップ３７を参照すること＊により、クラスタ管理テーブル３５を構成する各テーブルが格納されているフラッシュメモリ３３内の物理クラスタを特定できる。すなわち、クラスタ管理テーブル３５を構成するテーブルのテーブル番号をオフセットとしてクラスタ管理テーブル状態マップ３７を検索することにより、そのテーブルを格納するクラスタの物理クラスタ番号を取得することができる。例えば、「テーブル４」が格納されているクラスタのクラスタ番号は、クラスタ管理テーブル状態マップ３７内の「オフセット４」の位置に格納されている。

【００２１】このクラスタ管理テーブル状態マップ３７はフラッシュメモリ３３内の所定の領域に格納され、電源投入時にＣＰＵ１５内のＲＡＭへロードされる。クラスタ管理テーブル状態マップ３７は、データの読み出しまたは書き込み時に必ずＣＰＵ１５により参照されるため、このように電源投入時にＣＰＵ１５内のＲＡＭへロードされることによりデータの読み出しまたは書き込み処理を円滑に行うことができる。

【００２２】前述したように、本実施の形態の半導体記憶装置３１においてＣＰＵ１５はデータ処理の際にクラスタ管理テーブル３５およびクラスタ管理テーブル状態マップ３７を用いて、ホストコンピュータ１２から送信された論理セクタ番号をフラッシュメモリ３３内の物理セクタ番号に変換する。以下に本半導体記憶装置３１におけるデータ読み出し手順を説明する。

【００２３】図６はホストコンピュータ１２からデータ読み出し要求があったときの半導体記憶装置３１におけるデータ読み出し手順を示す。この図において、最初にホストコンピュータ１２からＣＨＳ（Cylinder/Head/Sector）形式のセクタ番号情報を取得する（Ｓ１）と、ＣＰＵ１５はこのＣＨＳ形式のセクタ番号情報を論理セクタ番号に変換する（Ｓ２）。ここで、ホストコンピュータ１２からのアドレス情報は前述のようにＣＨＳ形式のセクタ番号情報が送信される場合以外に、論理セクタ番号が直接送信される場合もあり、この場合は上記ステップＳ１、Ｓ２は不要となる。次にＣＰＵ１５は、論理セクタ番号から論理クラスタ番号と、論理クラスタ内のオフセットとを計算する（Ｓ３）。この計算は次式で行われる。

$$\text{論理クラスタ番号} = \mathrm{integer}\,(\text{論理セクタ番号}／\text{クラスタ当りのセクタ数}) \quad \cdots (1)$$

$$\text{クラスタ内のオフセット} = \text{論理セクタ番号} - \text{論理クラスタ番号} \times \text{クラスタ当りのセクタ数} \quad \cdots (2)$$

ここで、integer（）は（）内の数の整数部のみを取り出す関数である。

【００２４】ここで、論理セクタと物理セクタは同様にクラスタ管理されているため、それぞれのオフセットは等しくなるため物理クラスタ内のオフセットは式（２）で求められる。次に、算出された論理クラスタ番号のクラスタがどのクラスタ管理テーブル３５に属するかを求める。すなわち、クラスタ管理テーブル３５のテーブル番号およびテーブル内のオフセットを計算する（Ｓ４）。ここで、前述のようにクラスタ管理テーブル３５を構成する１つのテーブルは２５６個のクラスタを管理するため、これらの計算は次式で行われる。

テーブル番号＝integer（論理クラスタ番号／２５６）…（３）

テーブル内のオフセット＝論理クラスタ番号－テーブル番号×２５６…（４）

【００２５】ホストコンピュータ１２から送信された論理セクタ番号に対する物理クラスタ番号は、式（３）で求められるテーブル番号のテーブル内の式（４）で求められるオフセットの位置に格納されている。

【００２６】上記のようにテーブル番号が算出されると、このテーブルが格納されているフラッシュメモリ３３内の物理クラスタを求める。すなわち、クラスタ管理状態マップ３７を用いて、このテーブルが格納されるクラスタの物理クラスタ番号を取得する（Ｓ５）。テーブルが格納されるクラスタの物理クラスタ番号は、前述のようにクラスタ管理テーブル状態マップ３７が２バイト＊毎にクラスタ管理テーブル３５の各テーブルに対応する物理クラスタ番号を格納しているため、クラスタ管理テーブル状態マップ３７において、上記テーブル番号をオフセットとする位置に格納されているデータを読み出すことにより求められる。

【００２７】このようにして上記テーブルが格納されるクラスタの物理クラスタ番号が算出できるが、１クラスタは４セクタから構成されるため、さらに、該当するセクタを特定する必要がある。このため、上記テーブルが格納されるクラスタ内におけるテーブルのオフセットを次式により求める（Ｓ６）。

クラスタ内におけるテーブルのオフセット＝テーブル番号－integer（テーブル番号／クラスタ当りのセクタ数）×クラスタ当りのセクタ数　…（５）

【００２８】すなわち、クラスタ管理テーブル状態マップ３７から求められた物理クラスタ番号および式（５）により求められたオフセットにより、上記テーブルが格納される物理セクタが特定できる。このセクタの値をバッファ１７に読み出し、クラスタ管理テーブル３５において、式（４）で求められたオフセットの位置に格納さ※れるデータを読み出すことにより、論理クラスタ番号に対応する物理クラスタ番号を取得できる（Ｓ７）。

【００２９】この物理クラスタ番号と式（２）で求められたオフセットとから物理セクタ番号を次式により求める（Ｓ８）。

物理セクタ番号＝物理クラスタ番号×クラスタ当りのセクタ数＋オフセット　…（６）

【００３０】このようにして、ホストコンピュータ１２から送信される論理セクタ番号に対応した物理セクタ番号が特定されると、このセクタに格納されるデータが読み出される（Ｓ９）。以上のようにして、本実施の形態の半導体記憶装置３１においては、クラスタ管理テーブル３５およびクラスタ管理テーブル状態マップ３７を用いて、ホストコンピュータ１２により指定される論理セクタ番号をフラッシュメモリ３３内の物理セクタ番号へ変換することによりデータの読み出しができる。

【００３１】以下に、具体的な数値を用いて図６の手順について図７を参照して説明する。すなわち、クラスタ当りのセクタ数を「４」、ホストコンピュータ１２からのＣＨＳ形式のセクタ情報から得られた論理セクタ番号を「９２２７」とした場合のデータ読み出し手順について説明する。

【００３２】ホストコンピュータ１２からＣＨＳ形式のセクタ番号情報を取得し（Ｓ１）、ＣＰＵはこのＣＨＳ形式のセクタ番号情報を論理セクタ番号に変換した結果、論理セクタ番号「９２２７」を得ると（Ｓ２）、ＣＰＵは、式（１）により論理クラスタ番号と、論理クラスタ内のオフセットとを計算する（Ｓ３）。

論理クラスタ番号＝integer（９２２７／４）＝２３０６

クラスタ内のオフセット＝９２２７－２３０６×４＝３

【００３３】これにより、物理クラスタ内のオフセットが「３」であることがわかる。次に、論理クラスタ番号が「２３０６」のクラスタがどのクラスタ管理テーブル３５内のどのテーブルに属するかを求める。すなわち、クラスタ管理テーブル３５内のテーブルのテーブル番号およびテーブル内のオフセットを計算する（Ｓ４）。

テーブル番号＝integer（２３０６／２５６）＝９

テーブル内のオフセット＝２３０６－９×２５６＝２

【００３４】これにより、論理クラスタ番号が「２３０６」のクラスタの物理クラスタ番号は、「テーブル９」中の「オフセット２」の位置に格納されていることがわかる。

【００３５】次に、「テーブル９」を格納するクラスタの物理クラスタ番号をクラスタ管理テーブル状態マップ３７を用いて求める。すなわち、「テーブル９」の値はクラスタ管理テーブル状態マップ３７内の「オフセット９」にあり、図７の（ａ）に示すように「０３」となる。この「０３」は「クラスタ３」を示し、したがって、「テーブル９」は「クラスタ３」に格納されていることを示している。さらに、「クラスタ３」内のセクタを特定するため、式（５）を用いて「テーブル９」が格納されるクラスタ内の「テーブル９」のオフセットを求める（Ｓ６）。

クラスタ内のテーブル９のオフセット＝９－integer（９／４）×４＝１

【００３６】したがって、図７の（ｂ）に示すように「テーブル９」の値は、「クラスタ３」の「オフセット１」に存在する物理セクタに格納されていることがわか

る。このセクタの値をバッファ１７に読み出し、テーブル内のオフセットである「オフセット２」に格納されるデータを読み出すことにより、物理クラスタ番号が特定される（Ｓ７）。図７の（ｃ）に示すようにこの物理クラスタ番号は「０１」となる。この物理クラスタ番号とオフセットとから物理セクタ番号を求める（Ｓ８）。

物理セクタ番号＝１×４＋３＝７

このようにして、フラッシュメモリ３３内の物理セクタ番号として「７」が特定され、図７（ｂ）に示すように、フラッシュメモリ３３内の「セクタ７」に格納されるデータが読み出される（Ｓ９）。

【００３７】以上、本半導体記憶装置３１におけるデータの読み出し手順について説明したが、データの書き込み時の場合も同様にして行うことができる。すなわち、ホストコンピュータから送信される論理セクタ番号から上記手順にしたがいクラスタ管理テーブル３５およびクラスタ管理テーブル状態マップ３７を用いて物理セクタ番号に変換する。物理セクタ番号が特定されると、そのセクタに対して消去コマンドを実行することにより、そのセクタのデータを消去し、その後、そのセクタに対してホストコンピュータ１２から送信されたデータを書き込む。

【００３８】以上のようにして、本実施の形態の半導体記憶装置において、クラスタ管理テーブル３５およびクラスタ管理テーブル状態マップ３７を用いて、ホストコンピュータ１２により指定される論理セクタ番号をフラッシュメモリ３３内の物理セクタ番号へ変換することによりセクタを特定することができ、データの読み出しまたは書き込みができる。

【００３９】尚、上記説明においては、４セクタを１クラスタとしてクラスタ管理を行ったが、例えば、容量が３２メガバイトより小さい時はクラスタ当りのセクタ数を１に（このときはセクタ管理になる。）、容量が３２メガバイト以上６４メガバイトより小さい時はクラスタ当りのセクタ数を２に、容量が６４メガバイト以上１２８メガバイトより小さい時はクラスタ当りのセクタ数を４に、容量が１２８メガバイト以上２５６メガバイトより小さい時はクラスタ当りのセクタ数を８にというように、半導体記憶装置の容量の大きさに応じて変化させてもよい。このようにクラスタ当りのセクタ数を変化させることにより、記憶容量の大容量化に伴い管理すべきセクタ数が増加しても、クラスタサイズを大きくすることでクラスタ管理テーブル等に使用されるデータ領域の大きさを増加させることなくデータを管理することができる。

【００４０】以上のようにして、本実施の形態の半導体記憶装置３１においては、消去ブロックサイズが小さいフラッシュメモリ３３において、消去ブロックとセクタの大きさを同じにし、所定数のセクタを１クラスタとしてクラスタ単位で管理するために、クラスタ管理テーブル３５およびクラスタ管理テーブル３５内に格納される情報の位置情報を管理するクラスタ管理テーブル状態マップ３７をフラッシュメモリ３３内に設け、これらを用いてホストコンピュータ１２からの論理セクタ番号をフラッシュメモリ３３内の物理セクタ番号に変換することにより、従来フラッシュメモリ３３とは別にＲＡＭで構成されていたアドレス変換テーブルを必要としなくなり、ハード構成が簡単になる。また、起動時におけるアドレス変換テーブル構築のための処理時間がなくなり、またそれに伴う消費電流も減少する。

【００４１】

【発明の効果】本発明に係る第１半導体記憶装置によれば、情報処理機器から送信される論理セクタ番号とメモリ手段内の物理セクタタ番号とを関連づけた情報を有するアドレス管理テーブルと、アドレス管理テーブルにおける前記情報が格納されるメモリ部内の物理的位置情報を格納するテーブル状態マップとをメモリ部内に設けたことにより、メモリ部内において、論理セクタ番号から物理セクタ番号への変換が可能となるため、メモリ部の外部に別途アドレス変換用のテーブルを格納するメモリ部を設ける必要がない。また、メモリ部内にアドレス管理テーブルを設けているため、半導体記憶装置の起動時においてアドレス変換用のテーブルの構築処理を要せず、起動時の立ち上げ時間が短縮され、同時に起動時の消費電力も低減できる。

【００４２】本発明に係る第２半導体記憶装置によれば、データが複数のセクタからなるクラスタ単位で管理され、論理クラスタ番号と物理クラスタ番号とを関連づけたアドレス管理テーブルと、アドレス管理テーブルが格納する情報の位置情報を管理するテーブル状態マップとをメモリ部内に設けたことにより、第１半導体記憶装置と同様の効果が得られるとともに、第１半導体記憶装置と比較して前記アドレス管理テーブルの容量が少なくなり、またクラスタ当たりのセクタ数を変えることにより、前記メモリ部の容量が増加しても前記セクタ管理テーブルの容量を大きくすることなく対応できる。

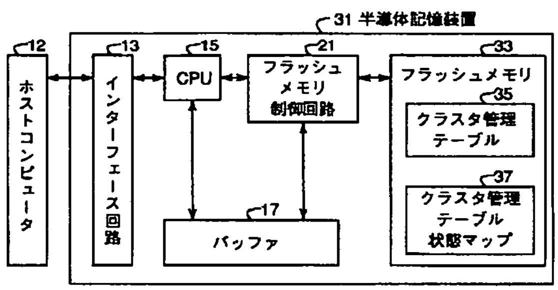
【００４３】本発明に係る第３半導体記憶装置において、前記アドレス管理テーブルが１セクタの大きさの少なくとも１つのテーブルから構成され、前記テーブル状態マップにより、前記アドレス管理テーブルを構成する前記テーブルのテーブル番号と前記テーブルが格納される前記メモリ部内の物理セクタ番号とが関連づけられることにより、前記メモリ部内の不連続なデータ領域においても前記アドレス管理テーブルを設けることができる。

【００４４】本発明に係る第４半導体記憶装置において、前記セクタの大きさを前記メモリの消去単位である消去ブロックの大きさと等しくすることにより、セクタ単位でのデータの消去や書き込みが可能となる。

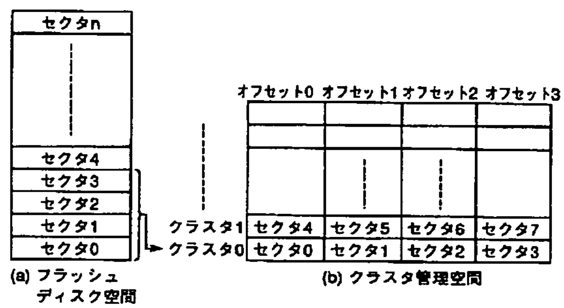
【図面の簡単な説明】

【図１】　本発明に係る半導体記憶装置の実施形態のブロック図。
【図２】　クラスタ管理を説明した図
【図３】　消去ブロックの構成図。
【図４】　クラスタ管理テーブルを説明した図。
【図５】　クラスタ管理テーブル状態マップを説明した図。
【図６】　本実施形態の半導体記憶装置のデータ読み出し手順を示すフローチャート。
【図７】　本実施形態の半導体記憶装置におけるクラスタ管理状態マップ、クラスタ管理テーブルおよびフラッシュメモリ空間の格納値の具体例を示す図。
【図８】　従来の半導体記憶装置のブロック図。
【符号の説明】
１１　半導体記憶装置（従来技術）、１２　ホストコンピュータ、１３　インターフェース回路、１５　ＣＰＵ、１７　バッファ、１９　アドレス変換テーブルＲＡＭ、２１　フラッシュメモリ制御回路、２３　フラッシュメモリ（従来技術）、３１　半導体記憶装置（本発明）、３３　フラッシュメモリ（本発明）、３５　クラスタ管理テーブル、３７　クラスタ管理テーブル状態マップ、４１データ記憶領域、４３　消去ブロック領域、４５　予備領域、４７　ＥＣＣ領域。

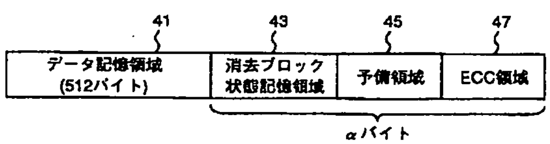
【図１】



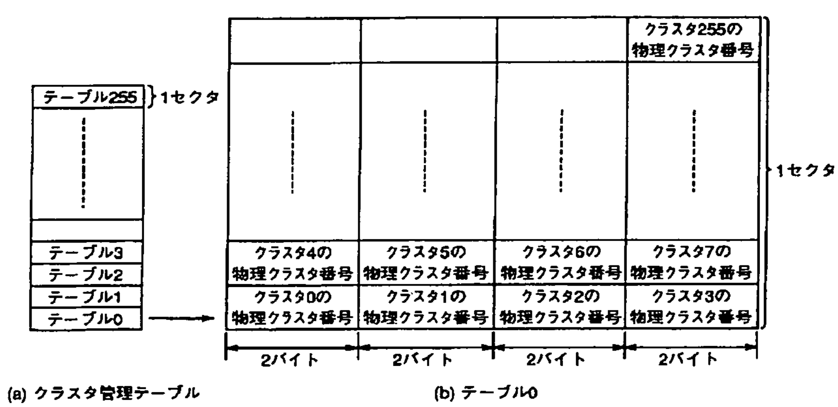
【図２】



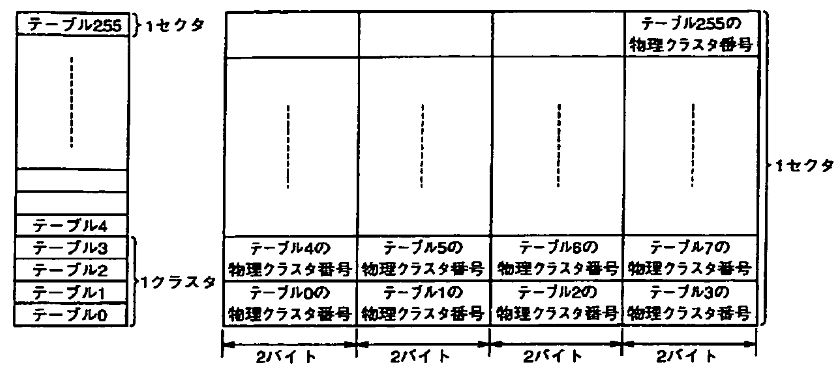
【図３】



【図４】

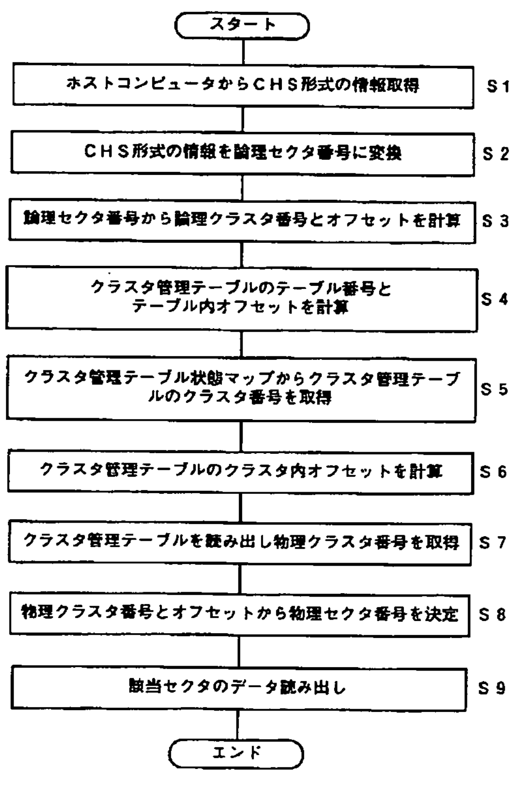


【図５】

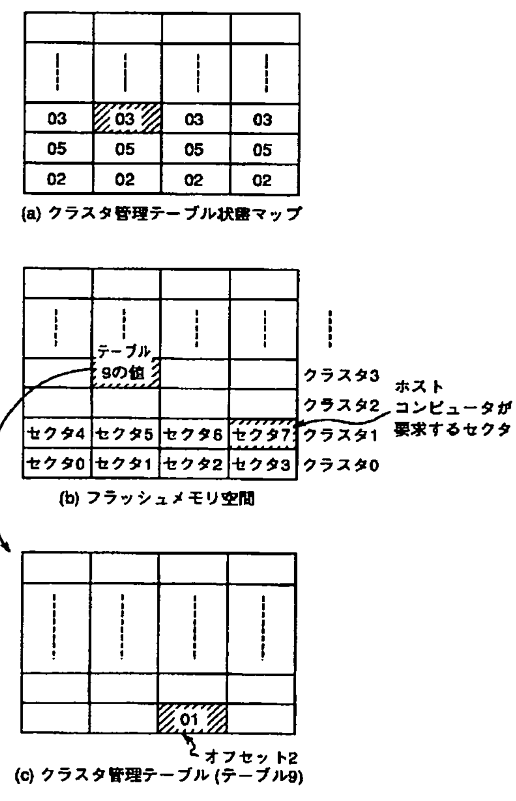


(a) クラスタ管理テーブル　　(b) クラスタ管理テーブル状態マップ

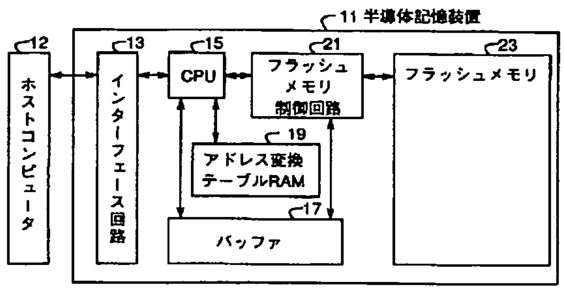
【図６】



【図７】



【図８】



【手続補正書】

【提出日】平成８年１１月７日

【手続補正１】

【補正対象書類名】明細書

【補正対象項目名】０００３

【補正方法】変更

【補正内容】

【０００３】フラッシュメモリ内のデータを書き換える時は、そのデータが含まれる消去ブロック全体を書き換える必要がある。例えば、５１２バイトのデータを書き換える場合では、その５１２バイトのデータが含まれる数Ｋバイトから数十Ｋバイトの消去ブロック内のデータを一旦別の領域に退避させ、そのブロックを消去した後、そのブロックに退避させたデータとともに新しいデータを書き込む必要がある。このため、書き込み効率が悪いという問題があった。また、フラッシュメモリにおいては、消去回数に上限があるため、特定の消去ブロックに書き込みが集中した際、短期間で消去回数の限界値を超えてしまい使用不可能になるという問題があった。

CLAIMS

[Claim(s)]
[Claim 1]A memory part which is connected to an information management system, consists of flash memories, and stores data per sector.
A control means which performs writing of data, or control of reading processing to said memory part.
An address administration table which stores information which associated a physical sector number which is an address for managing data within a logical sector number which is the semiconductor memory device provided with the above, and is an address for said information management system to manage data, and said memory part, Provide a table condition map which stores physical location information in said memory part in which said information in said address administration table is stored in said memory part, and said control means, When there is read-out of data or a demand of writing from said information management system, Said table condition map is referred to based on a logical sector number from said information management system, Said logical sector number is changed into said physical sector number based on a value of said address administration table which pinpoints a physical location where pertinent information on said logical sector number is stored, and is stored in a this pinpointed position.

[Claim 2]A memory part which is connected to an information management system, consists of flash memories, and stores data per sector.
It has a control means which performs writing of data, or control of reading processing to said memory part, and they are two or more sectors about data.
It is the semiconductor memory device provided with the above, An address administration table which stores information which associated a physical cluster number corresponding to a physical sector number which is an address for managing data within a logical cluster number

corresponding to a logical sector number which is an address for said information management system to manage data, and said memory means, Provide a table condition map which stores physical location information in said memory part in which said information in said address administration table is stored in said memory part, and said control means, When there is read-out of data or a demand of writing from said information management system, Based on a logical sector number from said information management system, calculate a logical cluster number and offset, and said table condition map is referred to based on said logical cluster number, A physical location where pertinent information on said logical cluster number is stored is pinpointed, Based on a value of said address administration table stored in a pinpointed this position, said logic Klas Tata number is changed into said physical cluster number, and a physical sector number is searched for from a this changed physical cluster number and said offset.

[Claim 3]In the semiconductor memory device according to claim 1 or 2, said address administration table comprises at least one table with a size of one sector, A semiconductor memory device, wherein said table condition map stores information which associated a table number for specifying said table which constitutes said address administration table, and a physical sector number in said memory part in which said table is stored.
[Claim 4]A semiconductor memory device characterized by a size of said sector being equal to a size of erase blocks which are elimination or a write-in unit of data in said flash memory in the semiconductor memory device according to claim 1 or 2.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the semiconductor memory device which carries block deletion type nonvolatile memory, such as a flash memory which can eliminate data, for every predetermined unit.
[0002]
[Description of the Prior Art]The small semiconductor memory device using a flash memory (it is the nonvolatile memory in which writing and elimination are possible electrically) without a drive system is spreading with the spread of portable information management systems, such as a portable computer and a digital still camera. Usually, as for the semiconductor memory device and information management system (a "host computer" is called hereafter.) using a flash memory, data transfer is performed per 512 bytes. In the flash memory carried in a semiconductor memory device, elimination of data is performed in the erase-blocks unit which is a predetermined data unit. The size of these erase blocks is tens of K bytes from several kilobytes, becomes [the unit (512 bytes) of the above-mentioned data transfer], and serves as a large value.
[0003]When rewriting the data in a flash memory, it is necessary to rewrite the whole erase blocks in which the data is contained. For example, in the case where 512 bytes of data is rewritten. After once evacuating the data in tens of [several to] K bytes in which 512 bytes of the data is contained of erase blocks to another field and eliminating the block, it is necessary to write in new data with the data evacuated to the block. For this reason, there was a problem that writing efficiency was bad. In the flash memory, since a number of erase times had a maximum, elimination and the writing of data needed to be performed, making the number of erase times of each block to some extent uniform.
[0004]In order to solve such a problem, there is a semiconductor memory device provided with

the address mapping table indicated by JP,5-27924,A, for example. The block diagram of the semiconductor memory device provided with this address mapping table is shown in drawing 8. The interface circuit 13 where the semiconductor memory device 11 exchanges data between the host computers 12 as shown in a figure, CPU15 which controls the semiconductor memory device 11 whole, and the buffer 17 which stores data temporarily while processing the data demanded from the host computer 12, Address mapping table RAM19 which stores the address mapping table which matches the logical sector address (logical sector number) transmitted from the host computer 12, and the physical sector address (physical sector number) inside a flash memory, It consists of the flash memory 23 which memorizes data, and the flash memory control circuit 21 which controls the flash memory 23. Address mapping table RAM19 comprises SRAM (static RAM) and a DRAM (dynamic RAM).

[0005]In such a semiconductor memory device 11, when CPU15 rewrites the data in the semiconductor memory device 11, While not processing the erase blocks of the origin containing the data to rewrite but writing new data in the free space in the flash memory 23 with the data of the original erase blocks, it is made to correspond to new erase blocks, and an address mapping table is rewritten. Henceforth, by referring to this address mapping table, CPU15 can match the logical sector address from the host computer 12, and the physical sector address in the flash memory 23, and can access the data in the flash memory 23.

[0006]

[Problem(s) to be Solved by the Invention]However, it is necessary to perform construction processing of an address mapping table in address mapping table RAM19 by searching all the data in a flash memory with the semiconductor memory device using such address mapping table RAM19 for a semiconductor memory device at the time of starting. For this reason, the processing time for construction processing of an address mapping table is needed, and there is a problem that a standup takes time. In the case of the low host computer 12 of power supplying, there is a problem that the host computer 12 is downed, for the power consumption at the time of this address mapping table construction processing. Since the address mapping table matches the logical address and the physical address per sector, With the increase in the capacity of a semiconductor memory device, an address mapping table needs to become large, also needs to enlarge capacity of address mapping table RAM19 which stores an address mapping table, and leads to the increase in cost of the whole semiconductor memory device.

[0007]that the above-mentioned problem should be solved, it is made and this invention comes out. The purpose shortens the build up time of **, and it is in even ** providing **************** about the power consumption at the time of starting.

[0008]

[Means for Solving the Problem]A memory part which the 1st semiconductor memory device concerning this invention is connected to an information management system, consists of flash memories, and stores data per sector, In a semiconductor memory device which has a control means which performs writing of data, or control of reading processing to said memory part, An address administration table which stores information which associated a physical sector number which is an address for managing data within a logical sector number which is an address for said information management system to manage data, and said memory part, A table condition map which stores physical location information in said memory part in which said information in said address administration table is stored is provided in said memory part. When there is read-out of data or a demand of writing from said information management system, said control means, Said table condition map is referred to based on a logical sector number from said information management system, Said logical sector number is changed into said physical sector number based on a value of said address administration table which pinpoints a physical location where pertinent information on said logical sector number is stored, and is stored in a this pinpointed position.

[0009]A memory part which the 2nd semiconductor memory device concerning this invention is connected to an information management system, consists of flash memories, and stores data per sector, In a semiconductor memory device which has a control means which performs writing of data, or control of reading processing to said memory part, and manages data by a cluster unit which consists of two or more sectors, An address administration table which stores information which associated a physical cluster number corresponding to a physical sector number which is an address for managing data within a logical cluster number corresponding to a logical sector number which is an address for said information management system to manage data, and said memory part, A table condition map which stores physical location information in said memory part in which said information in said address administration table is stored is provided in said memory means. When there is read-out of data or a demand of writing from said information management system, said control means, Based on a logical sector number from said information management system, calculate a logical cluster number and offset, and said table condition map is referred to based on said logical cluster number, A physical location where pertinent information on said logical cluster number is stored is pinpointed, Based on a value of said address administration table stored in a pinpointed this position, said logic Klas Tata number is changed into said physical cluster number, and a physical sector number is searched for from a this changed physical cluster number and said offset.

[0010]The 3rd semiconductor memory device concerning this invention comprises at least one table in which said address administration table has a size of one sector in the 2nd semiconductor memory device of the above. Information which associated a table number for

specifying said table where said table condition map constitutes said address administration table, and a physical sector number in said memory part in which said table is stored is stored.

[0011]The 4th semiconductor memory device concerning this invention makes a size of said sector equal to a size of erase blocks which are elimination or a write-in unit of data in said memory part in the above-mentioned semiconductor memory device.

[0012]

[Embodiment of the Invention]Hereafter, the embodiment of the semiconductor memory device applied to this invention with reference to an attached drawing is described. Drawing 1 shows the block diagram of the semiconductor memory device of this embodiment. In drawing 1, the same numerals show the same thing as the component which constitutes the conventional semiconductor memory device shown by drawing 8. As shown in drawing 1, the semiconductor memory device 31 comprises the interface circuit 13, CPU15, the buffer 17, the flash memory control circuit 21, and the flash memory 33. The flash memory 33 is further provided with the cluster management table 35 and the cluster management table status map 37. It is connected with the host computer 12 which is an information management system, and the semiconductor memory device 31 outputs and inputs data to the host computer 12.

[0013]In the semiconductor memory device 31, the interface circuit 13 delivers data between the semiconductor memory device 31 and the host computer 12. The flash memory 33 memorizes data and comprises eliminable nonvolatile memory electrically. CPU15 controls semiconductor memory device 31 inside. The flash memory control circuit 21 performs read-out and the writing of data to the flash memory 33 based on the control from CPU15. Under the present circumstances, the flash memory control circuit 21 performs data processing to the flash memory 33, storing data in the buffer 17 temporarily. Thus, a control means for CPU15 and the flash memory control circuit 21 to control the flash memory 33 is made.

[0014]The host computer 12 transmits the logical sector number which is a sector address of the data which requires processing of read-out or writing via the interface circuit 13 from the semiconductor memory device 31, when performing read-out or the writing of data to the semiconductor memory device 31. In the semiconductor memory device 31, CPU15 changes the logical sector number inputted via the interface circuit 13 into the physical sector number which is a sector address in the flash memory 33 using the cluster management table 35 and the cluster management table status map 37 in the flash memory 33, Read-out or the writing of data is performed to the field in the flash memory 33 specified by this physical sector number.

[0015]The data area in the flash memory 33 comprises two or more sectors, as shown in (a) of drawing 2. In this embodiment, the size of the erase blocks which are a size of this sector, the writing in the flash memory 33, or a unit of elimination is made the same, and, thereby, the writing or elimination of data can be performed per sector. The composition of the erase blocks (sector) in this embodiment is shown in drawing 3. Erase blocks comprise the data storage

area 41 (512 bytes), the erase-blocks state storage region 43, the reserve area 45, and the ECC field 47. Let the size be a 512+alpha byte (alpha is 16 bytes). Data is stored in the data storage area 41, and the information which shows the state of erase blocks, such as time which the number of erase times, elimination, and the writing of the erase blocks took, is stored in the erase-blocks state storage region 43. CPU15 measures the time which elimination took by an internal timer, and records it at the time of data writing. CPU15 can check the characteristic of each erase blocks with reference to these information. For example, CPU15 can check the time which elimination and the writing of each erase blocks took, and it can be considered that it is poor about what has required the time beyond predetermined time, and it can process substitution of a block, etc. The reserve area 45 is a field secured for the reserve, and data is not usually written in. The error correction code (ECC) calculated to the field of the erase blocks except the ECC field 47 in the flash memory control circuit 21 for every erase blocks is stored in the ECC field 47.

[0016]The semiconductor memory device 31 of this embodiment makes four sectors one cluster, as shown in (b) of drawing 2, and it manages data by a cluster unit. That is, the logical sector number transmitted from the host computer 12 and the physical sector number in the flash memory 33 are managed by a cluster unit, respectively. In such cluster management, the position of a sector is pinpointed by the cluster number which specifies a cluster, and the offset in a cluster. For example, the position is pinpointed by "the cluster 1" and the "offset 2" whose the "sector 6" whose sector number is a sector of 6 is a cluster of the cluster number 1. So, in this embodiment, in order to perform data management in a cluster unit, as shown in drawing 1, the cluster management table 35 and the cluster management table status map 37 are provided in the flash memory 33. Hereafter, the cluster management table 35 and the cluster management table status map 37 are explained.

[0017]The cluster management table 35 associates the logical cluster number transmitted from the host computer 12, and the physical cluster number in the flash memory 33 corresponding to it, and is making the address administration table means in this embodiment. CPU15 changes eventually into the physical sector number in the flash memory 33 the logical sector number transmitted from the host computer 12 using this cluster management table 35. Thus, by matching a physical sector number and a logical sector number with the cluster management table 35, use of the cluster containing the bad sector in the flash memory 33 is avoidable.

[0018]Drawing 4 is a figure showing the concept of the cluster management table 35. As shown in (a) of drawing 4, in this embodiment, the cluster management table 35 comprises 256 tables of "table 0" - "table 255." One table has 512 bytes of one sector, i.e., field, and manages the physical cluster number corresponding to the logical cluster number of 256 pieces. As the cluster management table 35 whole, it has a 512 byte x256=128K byte's field.

The logical cluster number managed between each table is continuing, for example, a logical cluster number manages the physical cluster number of 0-255, and, as for "the table 0", a logical cluster number manages the physical cluster number of 256-511, as for "the table 1." "Table 0" Each table of - "table 255" stores the physical cluster number corresponding to a logical cluster number in 2 bytes of field one by one, as shown in (b) of drawing 4. Therefore, the physical cluster number corresponding to a logical cluster number can be specified by the table number of the table which constitutes the cluster management table 35, and offset in a table. The cluster management table 35 as well as data is managed by a cluster unit by making four sectors (four tables) into one cluster.

[0019]Next, the cluster management table status map 37 is explained. The cluster management table status map 37 is for managing the physical cluster number which is a storing position in the flash memory 33 of the table which constitutes the cluster management table 35. That is, it is used in order to show where [in the flash memory 33] each table which constitutes the cluster management table 35 exists. When it cannot secure in the field which continued the cluster management table 35 in the flash memory 33 by this, the cluster management table 35 can be assigned to a discontinuous field. The composition of the cluster management table status map 37 is shown in drawing 5.

[0020]As shown in (b) of drawing 5, the cluster management table status map 37 consisted of a field of one sector, and has matched and managed the table number of the table which constitutes the cluster management table 35, and the physical cluster number of the cluster in which the table of the number is stored. That is, in 512 bytes of field of the cluster management table status map 37, the field of a table is assigned one by one every 2 bytes from a head, and the physical cluster number of the cluster which stores the table in an applicable field is stored. By referring to the cluster management table status map 37, CPU15 can specify the physical cluster in the flash memory 33 in which each table which constitutes the cluster management table 35 is stored. That is, the physical cluster number of the cluster which stores the table is acquirable by searching the cluster management table status map 37 by considering the table number of the table which constitutes the cluster management table 35 as offset. For example, the cluster number of the cluster in which "the table 4" is stored is stored in the position of the "offset 4" in the cluster management table status map 37.

[0021]This cluster management table status map 37 is stored in the predetermined field in the flash memory 33, and is loaded to RAM in CPU15 by the power up. Since the cluster management table status map 37 is certainly referred to by CPU15 at the time of read-out or the writing of data, when it is loaded to RAM in CPU15 by the power up in this way, it can perform read-out or writing processing of data smoothly.

[0022]As mentioned above, in the semiconductor memory device 31 of this embodiment, CPU15 uses the cluster management table 35 and the cluster management table status map

37 in the case of data processing, The logical sector number transmitted from the host computer 12 is changed into the physical sector number in the flash memory 33. The data read procedure in this semiconductor memory device 31 is explained below.

[0023]Drawing 6 shows the data read procedure in the semiconductor memory device 31 when there is a data read demand from the host computer 12. in this figure -- the beginning -- the sector number information on the host computer 12 to CHS (Cylinder/Head/Sector) form -- acquiring (S1) -- CPU15 changes the sector number information on this CHS form into a logical sector number (S2). Here, to the address information from the host computer 12, except when the sector number information on CHS form is transmitted as mentioned above, a logical sector number may be transmitted directly, and the above-mentioned step S1 and S2 become unnecessary in this case. Next, CPU15 calculates a logical cluster number and the offset in a logical cluster from a logical sector number (S3). This calculation is performed by the following formula.

Logical cluster number = integer (sector number per a logical sector number / cluster)
-- (1)
Offset in a cluster = sector number per logical sector number - logical cluster number x cluster
-- (2)
Here, integer() is a function which takes out only the integer part of the number in ().

[0024]Here, since cluster management of a logical sector and the physical sector is carried out similarly, and each offset becomes equal, the offset in a physical cluster is searched for by a formula (2). Next, it asks for to which cluster management table 35 the cluster of the computed logical cluster number belongs. That is, the offset in the table number of the cluster management table 35 and a table is calculated (S4). Here, these calculations are performed by the following formula in order that one table which constitutes the cluster management table 35 as mentioned above may manage 256 clusters.

Table number = integer (a logical cluster number/256) -- (3)
Offset in a table = logical cluster number-table number x256 -- (4)

[0025]The physical cluster number to the logical sector number transmitted from the host computer 12 is stored in the position of the offset searched for by the formula (4) in the table of the table number called for by a formula (3).

[0026]If a table number is computed as mentioned above, it will ask for the physical cluster in the flash memory 33 in which this table is stored. That is, the physical cluster number of the cluster in which this table is stored is acquired using the cluster controlled state map 37 (S5). The physical cluster number of the cluster in which a table is stored, Since the cluster management table status map 37 stores the physical cluster number corresponding to each table of the cluster management table 35 every 2 bytes as mentioned above, In the cluster management table status map 37, it asks by reading the data stored in the position which

considers the above-mentioned table number as offset.
[0027]Thus, although the physical cluster number of the cluster in which the above-mentioned table is stored is computable, since one cluster comprises four sectors, it needs to specify an applicable sector further. For this reason, offset of the table in the cluster in which the above-mentioned table is stored is searched for with a following formula (S6).
Offset of the table in a cluster = sector number per table number-integer(sector number per table number/cluster) x cluster -- (5)
[0028]That is, the physical sector in which the above-mentioned table is stored can be specified by offset searched for by the physical cluster number and formula (5) which were called for from the cluster management table status map 37. The physical cluster number corresponding to a logical cluster number is acquirable by reading the value of this sector to the buffer 17, and reading the data stored in the position of the offset searched for by the formula (4) in the cluster management table 35 (S7).
[0029]A physical sector number is searched for with a following formula from this physical cluster number and the offset searched for by the formula (2) (S8).
Physical sector number = sector number per physical cluster number x cluster + offset -- (6)
[0030]Thus, specification of the physical sector number corresponding to the logical sector number transmitted from the host computer 12 will read the data stored in this sector (S9). In the semiconductor memory device 31 of this embodiment as mentioned above, Read-out of data can be performed by changing into the physical sector number in the flash memory 33 the logical sector number specified by the host computer 12 using the cluster management table 35 and the cluster management table status map 37.
[0031]Below, the procedure of drawing 6 is explained with reference to drawing 7 using a concrete numerical value. That is, the data read procedure at the time of setting to "9227" the logical sector number which was able to obtain the sector number per cluster from the sector information of "4" and the CHS form from the host computer 12 is explained.
[0032]The sector number information on CHS form is acquired from the host computer 12 (S1), If CPU acquires the logical sector number "9227" as a result of changing the sector number information on this CHS form into a logical sector number (S2), CPU will calculate a logical cluster number and the offset in a logical cluster by a formula (1) (S3).
Logical cluster number = offset =9227-2306x4=3 in integer(9227/4) =2306 cluster [0033] Thereby, it turns out that the offset in a physical cluster is "3." Next, a logical cluster number asks for to which table in which cluster management table 35 the cluster of "2306" belongs. That is, the offset in the table number of the table in the cluster management table 35 and a table is calculated (S4).
Table number = offset =2306-9x256=2 in integer(2306/256) =9 table [0034]Thereby, it turns out that the logical cluster number is stored in the position of the "offset 2" in "the table 9" as

for the physical cluster number of the cluster of "2306."

[0035]Next, it asks for the physical cluster number of the cluster which stores "the table 9" using the cluster management table status map 37. That is, the value of "the table 9" is in the "offset 9" in the cluster management table status map 37, and as shown in (a) of drawing 7, it is set to "03." It is shown that this "03" shows "the cluster 3", therefore "the table 9" is stored in "the cluster 3." Since the sector in "the cluster 3" is specified, offset of the "table 9" in the cluster in which "the table 9" is stored using a formula (5) is searched for (S6).

Offset of the table 9 in a cluster = 9-integer(9/4) x4=1 [0036]Therefore, as shown in (b) of drawing 7, it turns out that the value of "the table 9" is stored in the physical sector which exists in the "offset 1" of "the cluster 3." A physical cluster number is specified by reading the value of this sector to the buffer 17, and reading the data stored in the "offset 2" which is offset in a table (S7). As shown in (c) of drawing 7, this physical cluster number is set to "01." A physical sector number is searched for from this physical cluster number and offset (S8).

"7" is specified as physical sector number =1x4+3=7, thus a physical sector number in the flash memory 33, and as shown in drawing 7 (b), the data stored in the "sector 7" in the flash memory 33 is read (S9).

[0037]As mentioned above, although the read-out procedure of the data in this semiconductor memory device 31 was explained, the case at the time of the writing of data can be performed similarly. That is, according to the above-mentioned procedure, it changes into a physical sector number from the logical sector number transmitted from a host computer using the cluster management table 35 and the cluster management table status map 37. If a physical sector number is specified, by executing a deletion command to the sector, the data of the sector will be eliminated and the data transmitted from the host computer 12 to the sector will be written in after that.

[0038]The cluster management table 35 and the cluster management table status map 37 are used [in / as mentioned above / the semiconductor memory device of this embodiment], By changing into the physical sector number in the flash memory 33 the logical sector number specified by the host computer 12, a sector can be specified and read-out or the writing of data is made.

[0039]Although cluster management was performed by making four sectors into one cluster in the above-mentioned explanation, time [for example,] capacity is smaller than 32 megabytes -- the sector number per cluster -- 1 -- (-- it becomes sector management at this time.). When capacity is smaller than 32 megabytes or more 64 megabytes, the sector number per cluster to 2. time capacity is smaller than 64 megabytes or more 128 megabytes -- the sector number per cluster -- 4 -- time capacity is smaller than 128 megabytes or more 256 megabytes -- the sector number per cluster -- 8 -- as -- it may be made to change according to the size of the capacity of a semiconductor memory device Thus, even if the sector number which should be

managed with large-scale-izing of a storage capacity by changing the sector number per cluster increases, data can be managed, without making the size of the data area used for a cluster management table etc. by enlarging a cluster size increase.

[0040]In the semiconductor memory device 31 of this embodiment as mentioned above, In order for erase block size to make the size of erase blocks and a sector the same, to make the sector of a predetermined number one cluster in the small flash memory 33 and to manage by a cluster unit, The cluster management table status map 37 which manages the position information on the information stored in the cluster management table 35 and the cluster management table 35 is formed in the flash memory 33, By changing the logical sector number from the host computer 12 into the physical sector number in the flash memory 33 using these, it stops needing the address mapping table which comprised RAM conventionally independently [the flash memory 33], and hard structure becomes easy. The processing time for the address mapping table construction at the time of starting is lost, and the consumed electric current accompanying it also decreases.

[0041]

[Effect of the Invention]The address administration table which has the information which associated the logical sector number transmitted from an information management system, and the physical SEKUTATA number within a memory means according to the 1st semiconductor memory device concerning this invention, By having provided the table condition map which stores the physical location information in the memory part in which said information in an address administration table is stored in the memory part, In a memory part, since the conversion for a physical sector number from a logical sector number is attained, it is not necessary to provide the memory part which stores the table for address translation in the exterior of a memory part separately. Since the address administration table is provided in the memory part, at the time of starting of a semiconductor memory device, construction processing of the table for address translation is not required, but the rise time at the time of starting is shortened, and the power consumption at the time of starting can also be reduced simultaneously.

[0042]The address administration table which according to the 2nd semiconductor memory device concerning this invention data was managed by the cluster unit which consists of two or more sectors, and associated the logical cluster number and the physical cluster number, While the same effect as the 1st semiconductor memory device is acquired by having provided the table condition map which manages the position information on the information which an address administration table stores in the memory part, It can respond by the capacity of said address administration table decreasing as compared with the 1st semiconductor memory device, and changing the sector number per cluster, without enlarging capacity of said sector management table, even if the capacity of said memory part increases.

[0043]In the 3rd semiconductor memory device concerning this invention, it is constituted from at least one table of the size of one sector by said address administration table, and on said table condition map. By associating the table number of said table which constitutes said address administration table, and the physical sector number in said memory part in which said table is stored, said address administration table can be provided also in the discontinuous data area in said memory part.

[0044]In the 4th semiconductor memory device concerning this invention, elimination and the writing of data in a sector unit are attained by making the size of said sector equal to the size of the erase blocks which are the elimination units of said memory.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention]This invention relates to the semiconductor memory device which carries block deletion type nonvolatile memory, such as a flash memory which can eliminate data, for every predetermined unit.

[Translation done.]

PRIOR ART

[Description of the Prior Art]The small semiconductor memory device using a flash memory (it is the nonvolatile memory in which writing and elimination are possible electrically) without a drive system is spreading with the spread of portable information management systems, such as a portable computer and a digital still camera. Usually, as for the semiconductor memory device and information management system (a "host computer" is called hereafter.) using a flash memory, data transfer is performed per 512 bytes. In the flash memory carried in a semiconductor memory device, elimination of data is performed in the erase-blocks unit which is a predetermined data unit. The size of these erase blocks is tens of K bytes from several kilobytes, becomes [the unit (512 bytes) of the above-mentioned data transfer], and serves as a large value.
[0003]When rewriting the data in a flash memory, it is necessary to rewrite the whole erase blocks in which the data is contained. For example, in the case where 512 bytes of data is rewritten. After once evacuating the data in tens of [several to] K bytes in which 512 bytes of the data is contained of erase blocks to another field and eliminating the block, it is necessary to write in new data with the data evacuated to the block. For this reason, there was a problem that writing efficiency was bad. In the flash memory, since a number of erase times had a maximum, elimination and the writing of data needed to be performed, making the number of erase times of each block to some extent uniform.
[0004]In order to solve such a problem, there is a semiconductor memory device provided with the address mapping table indicated by JP,5-27924,A, for example. The block diagram of the semiconductor memory device provided with this address mapping table is shown in drawing 8. The interface circuit 13 where the semiconductor memory device 11 exchanges data between the host computers 12 as shown in a figure, CPU15 which controls the semiconductor memory device 11 whole, and the buffer 17 which stores data temporarily while processing the data demanded from the host computer 12, Address mapping table RAM19 which stores the

address mapping table which matches the logical sector address (logical sector number) transmitted from the host computer 12, and the physical sector address (physical sector number) inside a flash memory, It consists of the flash memory 23 which memorizes data, and the flash memory control circuit 21 which controls the flash memory 23. Address mapping table RAM19 comprises SRAM (static RAM) and a DRAM (dynamic RAM).

[0005]In such a semiconductor memory device 11, when CPU15 rewrites the data in the semiconductor memory device 11, While not processing the erase blocks of the origin containing the data to rewrite but writing new data in the free space in the flash memory 23 with the data of the original erase blocks, it is made to correspond to new erase blocks, and an address mapping table is rewritten. Henceforth, by referring to this address mapping table, CPU15 can match the logical sector address from the host computer 12, and the physical sector address in the flash memory 23, and can access the data in the flash memory 23.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]The address administration table which has the information which associated the logical sector number transmitted from an information management system, and the physical SEKUTATA number within a memory means according to the 1st semiconductor memory device concerning this invention, By having provided the table condition map which stores the physical location information in the memory part in which said information in an address administration table is stored in the memory part, In a memory part, since the conversion for a physical sector number from a logical sector number is attained, it is not necessary to provide the memory part which stores the table for address translation in the exterior of a memory part separately. Since the address administration table is provided in the memory part, at the time of starting of a semiconductor memory device, construction processing of the table for address translation is not required, but the rise time at the time of starting is shortened, and the power consumption at the time of starting can also be reduced simultaneously.
[0042]The address administration table which according to the 2nd semiconductor memory device concerning this invention data was managed by the cluster unit which consists of two or more sectors, and associated the logical cluster number and the physical cluster number, While the same effect as the 1st semiconductor memory device is acquired by having provided the table condition map which manages the position information on the information which an address administration table stores in the memory part, It can respond by the capacity of said address administration table decreasing as compared with the 1st semiconductor memory device, and changing the sector number per cluster, without enlarging capacity of said sector management table, even if the capacity of said memory part increases.
[0043]In the 3rd semiconductor memory device concerning this invention, it is constituted from at least one table of the size of one sector by said address administration table, and on said table condition map. By associating the table number of said table which constitutes said

address administration table, and the physical sector number in said memory part in which said table is stored, said address administration table can be provided also in the discontinuous data area in said memory part.

[0044]In the 4th semiconductor memory device concerning this invention, elimination and the writing of data in a sector unit are attained by making the size of said sector equal to the size of the erase blocks which are the elimination units of said memory.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, it is necessary to perform construction processing of an address mapping table in address mapping table RAM19 by searching all the data in a flash memory with the semiconductor memory device using such address mapping table RAM19 for a semiconductor memory device at the time of starting. For this reason, the processing time for construction processing of an address mapping table is needed, and there is a problem that a standup takes time. In the case of the low host computer 12 of power supplying, there is a problem that the host computer 12 is downed, for the power consumption at the time of this address mapping table construction processing. Since the address mapping table matches the logical address and the physical address per sector, With the increase in the capacity of a semiconductor memory device, an address mapping table needs to become large, also needs to enlarge capacity of address mapping table RAM19 which stores an address mapping table, and leads to the increase in cost of the whole semiconductor memory device.
[0007]that the above-mentioned problem should be solved, it is made and this invention comes out. The purpose shortens the build up time of **, and it is in even ** providing **************** about the power consumption at the time of starting.

[Translation done.]

MEANS

[Means for Solving the Problem]A memory part which the 1st semiconductor memory device concerning this invention is connected to an information management system, consists of flash memories, and stores data per sector, In a semiconductor memory device which has a control means which performs writing of data, or control of reading processing to said memory part, An address administration table which stores information which associated a physical sector number which is an address for managing data within a logical sector number which is an address for said information management system to manage data, and said memory part, A table condition map which stores physical location information in said memory part in which said information in said address administration table is stored is provided in said memory part. When there is read-out of data or a demand of writing from said information management system, said control means, Said table condition map is referred to based on a logical sector number from said information management system, Said logical sector number is changed into said physical sector number based on a value of said address administration table which pinpoints a physical location where pertinent information on said logical sector number is stored, and is stored in a this pinpointed position.
[0009]A memory part which the 2nd semiconductor memory device concerning this invention is connected to an information management system, consists of flash memories, and stores data per sector, In a semiconductor memory device which has a control means which performs writing of data, or control of reading processing to said memory part, and manages data by a cluster unit which consists of two or more sectors, An address administration table which stores information which associated a physical cluster number corresponding to a physical sector number which is an address for managing data within a logical cluster number corresponding to a logical sector number which is an address for said information management system to manage data, and said memory part, A table condition map which stores physical location information in said memory part in which said information in said

address administration table is stored is provided in said memory means. When there is read-out of data or a demand of writing from said information management system, said control means, Based on a logical sector number from said information management system, calculate a logical cluster number and offset, and said table condition map is referred to based on said logical cluster number, A physical location where pertinent information on said logical cluster number is stored is pinpointed, Based on a value of said address administration table stored in a pinpointed this position, said logic Klas Tata number is changed into said physical cluster number, and a physical sector number is searched for from a this changed physical cluster number and said offset.

[0010]The 3rd semiconductor memory device concerning this invention comprises at least one table in which said address administration table has a size of one sector in the 2nd semiconductor memory device of the above. Information which associated a table number for specifying said table where said table condition map constitutes said address administration table, and a physical sector number in said memory part in which said table is stored is stored.

[0011]The 4th semiconductor memory device concerning this invention makes a size of said sector equal to a size of erase blocks which are elimination or a write-in unit of data in said memory part in the above-mentioned semiconductor memory device.

[0012]

[Embodiment of the Invention]Hereafter, the embodiment of the semiconductor memory device applied to this invention with reference to an attached drawing is described. Drawing 1 shows the block diagram of the semiconductor memory device of this embodiment. In drawing 1, the same numerals show the same thing as the component which constitutes the conventional semiconductor memory device shown by drawing 8. As shown in drawing 1, the semiconductor memory device 31 comprises the interface circuit 13, CPU15, the buffer 17, the flash memory control circuit 21, and the flash memory 33. The flash memory 33 is further provided with the cluster management table 35 and the cluster management table status map 37. It is connected with the host computer 12 which is an information management system, and the semiconductor memory device 31 outputs and inputs data to the host computer 12.

[0013]In the semiconductor memory device 31, the interface circuit 13 delivers data between the semiconductor memory device 31 and the host computer 12. The flash memory 33 memorizes data and comprises eliminable nonvolatile memory electrically. CPU15 controls semiconductor memory device 31 inside. The flash memory control circuit 21 performs read-out and the writing of data to the flash memory 33 based on the control from CPU15. Under the present circumstances, the flash memory control circuit 21 performs data processing to the flash memory 33, storing data in the buffer 17 temporarily. Thus, a control means for CPU15 and the flash memory control circuit 21 to control the flash memory 33 is made.

[0014]The host computer 12 transmits the logical sector number which is a sector address of

the data which requires processing of read-out or writing via the interface circuit 13 from the semiconductor memory device 31, when performing read-out or the writing of data to the semiconductor memory device 31. In the semiconductor memory device 31, CPU15 changes the logical sector number inputted via the interface circuit 13 into the physical sector number which is a sector address in the flash memory 33 using the cluster management table 35 and the cluster management table status map 37 in the flash memory 33, Read-out or the writing of data is performed to the field in the flash memory 33 specified by this physical sector number.
[0015]The data area in the flash memory 33 comprises two or more sectors, as shown in (a) of drawing 2. In this embodiment, the size of the erase blocks which are a size of this sector, the writing in the flash memory 33, or a unit of elimination is made the same, and, thereby, the writing or elimination of data can be performed per sector. The composition of the erase blocks (sector) in this embodiment is shown in drawing 3. Erase blocks comprise the data storage area 41 (512 bytes), the erase-blocks state storage region 43, the reserve area 45, and the ECC field 47. Let the size be a 512+alpha byte (alpha is 16 bytes). Data is stored in the data storage area 41, and the information which shows the state of erase blocks, such as time which the number of erase times, elimination, and the writing of the erase blocks took, is stored in the erase-blocks state storage region 43. CPU15 measures the time which elimination took by an internal timer, and records it at the time of data writing. CPU15 can check the characteristic of each erase blocks with reference to these information. For example, CPU15 can check the time which elimination and the writing of each erase blocks took, and it can be considered that it is poor about what has required the time beyond predetermined time, and it can process substitution of a block, etc. The reserve area 45 is a field secured for the reserve, and data is not usually written in. The error correction code (ECC) calculated to the field of the erase blocks except the ECC field 47 in the flash memory control circuit 21 for every erase blocks is stored in the ECC field 47.
[0016]The semiconductor memory device 31 of this embodiment makes four sectors one cluster, as shown in (b) of drawing 2, and it manages data by a cluster unit. That is, the logical sector number transmitted from the host computer 12 and the physical sector number in the flash memory 33 are managed by a cluster unit, respectively. In such cluster management, the position of a sector is pinpointed by the cluster number which specifies a cluster, and the offset in a cluster. For example, the position is pinpointed by "the cluster 1" and the "offset 2" whose the "sector 6" whose sector number is a sector of 6 is a cluster of the cluster number 1. So, in this embodiment, in order to perform data management in a cluster unit, as shown in drawing 1, the cluster management table 35 and the cluster management table status map 37 are provided in the flash memory 33. Hereafter, the cluster management table 35 and the cluster management table status map 37 are explained.
[0017]The cluster management table 35 associates the logical cluster number transmitted from

the host computer 12, and the physical cluster number in the flash memory 33 corresponding to it, and is making the address administration table means in this embodiment. CPU15 changes eventually into the physical sector number in the flash memory 33 the logical sector number transmitted from the host computer 12 using this cluster management table 35. Thus, by matching a physical sector number and a logical sector number with the cluster management table 35, use of the cluster containing the bad sector in the flash memory 33 is avoidable.

[0018]Drawing 4 is a figure showing the concept of the cluster management table 35. As shown in (a) of drawing 4, in this embodiment, the cluster management table 35 comprises 256 tables of "table 0" - "table 255." One table has 512 bytes of one sector, i.e., field, and manages the physical cluster number corresponding to the logical cluster number of 256 pieces. As the cluster management table 35 whole, it has a 512 byte x256=128K byte's field. The logical cluster number managed between each table is continuing, for example, a logical cluster number manages the physical cluster number of 0-255, and, as for "the table 0", a logical cluster number manages the physical cluster number of 256-511, as for "the table 1." "Table 0" Each table of - "table 255" stores the physical cluster number corresponding to a logical cluster number in 2 bytes of field one by one, as shown in (b) of drawing 4. Therefore, the physical cluster number corresponding to a logical cluster number can be specified by the table number of the table which constitutes the cluster management table 35, and offset in a table. The cluster management table 35 as well as data is managed by a cluster unit by making four sectors (four tables) into one cluster.

[0019]Next, the cluster management table status map 37 is explained. The cluster management table status map 37 is for managing the physical cluster number which is a storing position in the flash memory 33 of the table which constitutes the cluster management table 35. That is, it is used in order to show where [in the flash memory 33] each table which constitutes the cluster management table 35 exists. When it cannot secure in the field which continued the cluster management table 35 in the flash memory 33 by this, the cluster management table 35 can be assigned to a discontinuous field. The composition of the cluster management table status map 37 is shown in drawing 5.

[0020]As shown in (b) of drawing 5, the cluster management table status map 37 consisted of a field of one sector, and has matched and managed the table number of the table which constitutes the cluster management table 35, and the physical cluster number of the cluster in which the table of the number is stored. That is, in 512 bytes of field of the cluster management table status map 37, the field of a table is assigned one by one every 2 bytes from a head, and the physical cluster number of the cluster which stores the table in an applicable field is stored. By referring to the cluster management table status map 37, CPU15 can specify the physical cluster in the flash memory 33 in which each table which constitutes

the cluster management table 35 is stored. That is, the physical cluster number of the cluster which stores the table is acquirable by searching the cluster management table status map 37 by considering the table number of the table which constitutes the cluster management table 35 as offset. For example, the cluster number of the cluster in which "the table 4" is stored is stored in the position of the "offset 4" in the cluster management table status map 37.

[0021]This cluster management table status map 37 is stored in the predetermined field in the flash memory 33, and is loaded to RAM in CPU15 by the power up. Since the cluster management table status map 37 is certainly referred to by CPU15 at the time of read-out or the writing of data, when it is loaded to RAM in CPU15 by the power up in this way, it can perform read-out or writing processing of data smoothly.

[0022]As mentioned above, in the semiconductor memory device 31 of this embodiment, CPU15 uses the cluster management table 35 and the cluster management table status map 37 in the case of data processing, The logical sector number transmitted from the host computer 12 is changed into the physical sector number in the flash memory 33. The data read procedure in this semiconductor memory device 31 is explained below.

[0023]Drawing 6 shows the data read procedure in the semiconductor memory device 31 when there is a data read demand from the host computer 12. in this figure -- the beginning -- the sector number information on the host computer 12 to CHS (Cylinder/Head/Sector) form -- acquiring (S1) -- CPU15 changes the sector number information on this CHS form into a logical sector number (S2). Here, to the address information from the host computer 12, except when the sector number information on CHS form is transmitted as mentioned above, a logical sector number may be transmitted directly, and the above-mentioned step S1 and S2 become unnecessary in this case. Next, CPU15 calculates a logical cluster number and the offset in a logical cluster from a logical sector number (S3). This calculation is performed by the following formula.

Logical cluster number = integer (sector number per a logical sector number / cluster)

-- (1)

Offset in a cluster = sector number per logical sector number - logical cluster number x cluster

-- (2)

Here, integer() is a function which takes out only the integer part of the number in ().

[0024]Here, since cluster management of a logical sector and the physical sector is carried out similarly, and each offset becomes equal, the offset in a physical cluster is searched for by a formula (2). Next, it asks for to which cluster management table 35 the cluster of the computed logical cluster number belongs. That is, the offset in the table number of the cluster management table 35 and a table is calculated (S4). Here, these calculations are performed by the following formula in order that one table which constitutes the cluster management table 35 as mentioned above may manage 256 clusters.

Table number = integer (a logical cluster number/256) -- (3)
Offset in a table = logical cluster number-table number x256 -- (4)
[0025]The physical cluster number to the logical sector number transmitted from the host computer 12 is stored in the position of the offset searched for by the formula (4) in the table of the table number called for by a formula (3).
[0026]If a table number is computed as mentioned above, it will ask for the physical cluster in the flash memory 33 in which this table is stored. That is, the physical cluster number of the cluster in which this table is stored is acquired using the cluster controlled state map 37 (S5). The physical cluster number of the cluster in which a table is stored, Since the cluster management table status map 37 stores the physical cluster number corresponding to each table of the cluster management table 35 every 2 bytes as mentioned above, In the cluster management table status map 37, it asks by reading the data stored in the position which considers the above-mentioned table number as offset.
[0027]Thus, although the physical cluster number of the cluster in which the above-mentioned table is stored is computable, since one cluster comprises four sectors, it needs to specify an applicable sector further. For this reason, offset of the table in the cluster in which the above-mentioned table is stored is searched for with a following formula (S6).
sector number per offset = table number-integer(sector number per table number/cluster) x cluster of the table in a cluster -- (5)
[0028]That is, the physical sector in which the above-mentioned table is stored can be specified by offset searched for by the physical cluster number and formula (5) which were called for from the cluster management table status map 37. The physical cluster number corresponding to a logical cluster number is acquirable by reading the value of this sector to the buffer 17, and reading the data stored in the position of the offset searched for by the formula (4) in the cluster management table 35 (S7).
[0029]A physical sector number is searched for with a following formula from this physical cluster number and the offset searched for by the formula (2) (S8).
Physical sector number = sector number per physical cluster number x cluster + offset -- (6)
[0030]Thus, specification of the physical sector number corresponding to the logical sector number transmitted from the host computer 12 will read the data stored in this sector (S9). In the semiconductor memory device 31 of this embodiment as mentioned above, Read-out of data can be performed by changing into the physical sector number in the flash memory 33 the logical sector number specified by the host computer 12 using the cluster management table 35 and the cluster management table status map 37.
[0031]Below, the procedure of drawing 6 is explained with reference to drawing 7 using a concrete numerical value. That is, the data read procedure at the time of setting to "9227" the logical sector number which was able to obtain the sector number per cluster from the sector

information of "4" and the CHS form from the host computer 12 is explained.

[0032]The sector number information on CHS form is acquired from the host computer 12 (S1), If CPU acquires the logical sector number "9227" as a result of changing the sector number information on this CHS form into a logical sector number (S2), CPU will calculate a logical cluster number and the offset in a logical cluster by a formula (1) (S3).

Logical cluster number = offset =9227-2306x4=3 in integer(9227/4) =2306 cluster [0033] Thereby, it turns out that the offset in a physical cluster is "3." Next, a logical cluster number asks for to which table in which cluster management table 35 the cluster of "2306" belongs. That is, the offset in the table number of the table in the cluster management table 35 and a table is calculated (S4).

Table number = offset =2306-9x256=2 in integer(2306/256) =9 table [0034]Thereby, it turns out that the logical cluster number is stored in the position of the "offset 2" in "the table 9" as for the physical cluster number of the cluster of "2306."

[0035]Next, it asks for the physical cluster number of the cluster which stores "the table 9" using the cluster management table status map 37. That is, the value of "the table 9" is in the "offset 9" in the cluster management table status map 37, and as shown in (a) of drawing 7, it is set to "03." It is shown that this "03" shows "the cluster 3", therefore "the table 9" is stored in "the cluster 3." Since the sector in "the cluster 3" is specified, offset of the "table 9" in the cluster in which "the table 9" is stored using a formula (5) is searched for (S6).

Offset of the table 9 in a cluster = 9-integer(9/4) x4=1 [0036]Therefore, as shown in (b) of drawing 7, it turns out that the value of "the table 9" is stored in the physical sector which exists in the "offset 1" of "the cluster 3." A physical cluster number is specified by reading the value of this sector to the buffer 17, and reading the data stored in the "offset 2" which is offset in a table (S7). As shown in (c) of drawing 7, this physical cluster number is set to "01." A physical sector number is searched for from this physical cluster number and offset (S8).

"7" is specified as physical sector number =1x4+3=7, thus a physical sector number in the flash memory 33, and as shown in drawing 7 (b), the data stored in the "sector 7" in the flash memory 33 is read (S9).

[0037]As mentioned above, although the read-out procedure of the data in this semiconductor memory device 31 was explained, the case at the time of the writing of data can be performed similarly. That is, according to the above-mentioned procedure, it changes into a physical sector number from the logical sector number transmitted from a host computer using the cluster management table 35 and the cluster management table status map 37. If a physical sector number is specified, by executing a deletion command to the sector, the data of the sector will be eliminated and the data transmitted from the host computer 12 to the sector will be written in after that.

[0038]The cluster management table 35 and the cluster management table status map 37 are

used [in / as mentioned above / the semiconductor memory device of this embodiment], By changing into the physical sector number in the flash memory 33 the logical sector number specified by the host computer 12, a sector can be specified and read-out or the writing of data is made.

[0039]Although cluster management was performed by making four sectors into one cluster in the above-mentioned explanation, time [for example,] capacity is smaller than 32 megabytes -- the sector number per cluster -- 1 -- (-- it becomes sector management at this time.). When capacity is smaller than 32 megabytes or more 64 megabytes, the sector number per cluster to 2. time capacity is smaller than 64 megabytes or more 128 megabytes -- the sector number per cluster -- 4 -- time capacity is smaller than 128 megabytes or more 256 megabytes -- the sector number per cluster -- 8 -- as -- it may be made to change according to the size of the capacity of a semiconductor memory device Thus, even if the sector number which should be managed with large-scale-izing of a storage capacity by changing the sector number per cluster increases, data can be managed, without making the size of the data area used for a cluster management table etc. by enlarging a cluster size increase.

[0040]In the semiconductor memory device 31 of this embodiment as mentioned above, In order for erase block size to make the size of erase blocks and a sector the same, to make the sector of a predetermined number one cluster in the small flash memory 33 and to manage by a cluster unit, The cluster management table status map 37 which manages the position information on the information stored in the cluster management table 35 and the cluster management table 35 is formed in the flash memory 33, By changing the logical sector number from the host computer 12 into the physical sector number in the flash memory 33 using these, it stops needing the address mapping table which comprised RAM conventionally independently [the flash memory 33], and hard structure becomes easy. The processing time for the address mapping table construction at the time of starting is lost, and the consumed electric current accompanying it also decreases.

[Translation done.]

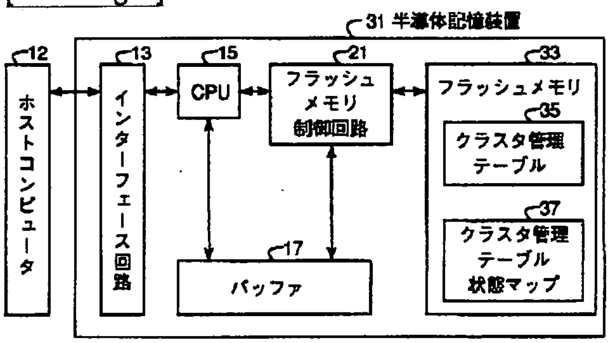
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The block diagram of the embodiment of the semiconductor memory device concerning this invention.
[Drawing 2]The figure explaining cluster management
[Drawing 3]The lineblock diagram of erase blocks.
[Drawing 4]The figure explaining a cluster management table.
[Drawing 5]The figure explaining a cluster management table status map.
[Drawing 6]The flow chart which shows the data read procedure of the semiconductor memory device of this embodiment.
[Drawing 7]The figure showing the example of the storing value of the cluster controlled state map in the semiconductor memory device of this embodiment, a cluster management table, and flash memory space.
[Drawing 8]The block diagram of the conventional semiconductor memory device.
[Description of Notations]
11 A semiconductor memory device (conventional technology) and 12 A host computer, 13 interface circuits, 15 CPU and 17 A buffer, 19 address-mapping-table RAM, 21 A flash memory control circuit and 23 Flash memory (conventional technology), 31 A semiconductor memory device (this invention) and 33 A flash memory (this invention), 35 cluster management tables, 37 cluster-management-table status map, 41 data storage areas, 43 erase-blocks field, and 45 A reserve area, 47 ECC field.

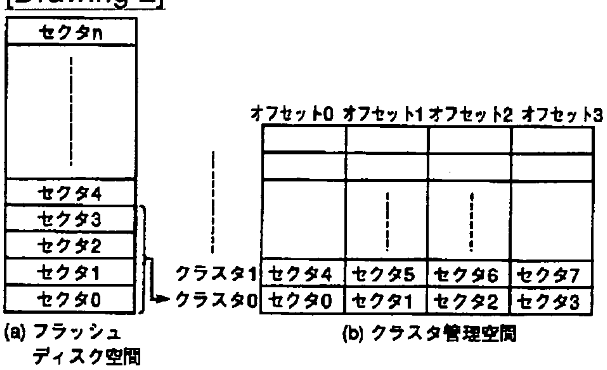
[Translation done.]

DRAWINGS

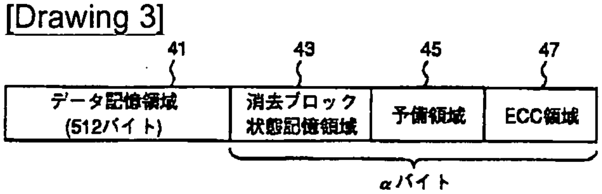
[Drawing 1]



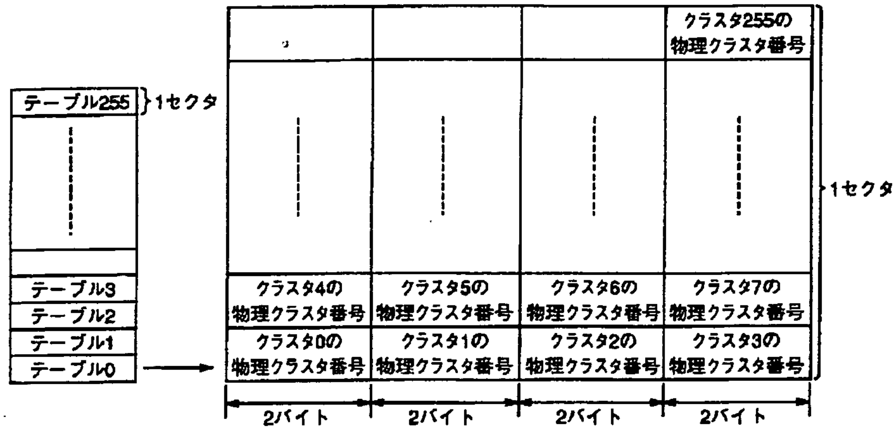
[Drawing 2]



[Drawing 3]

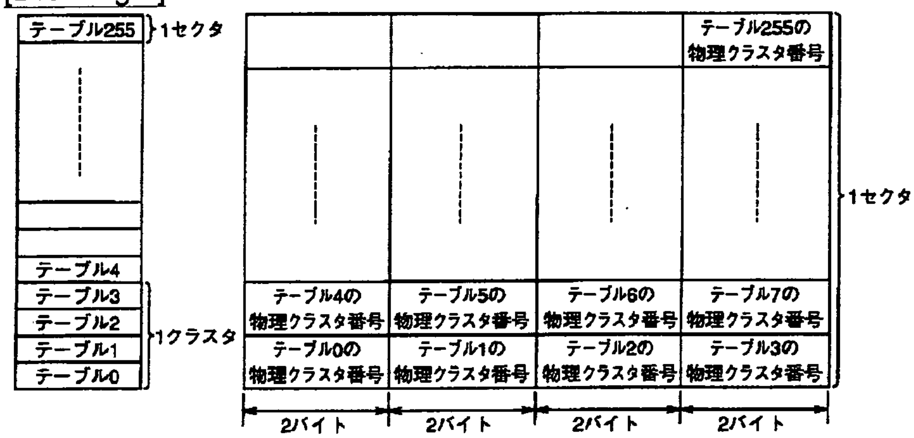


[Drawing 4]



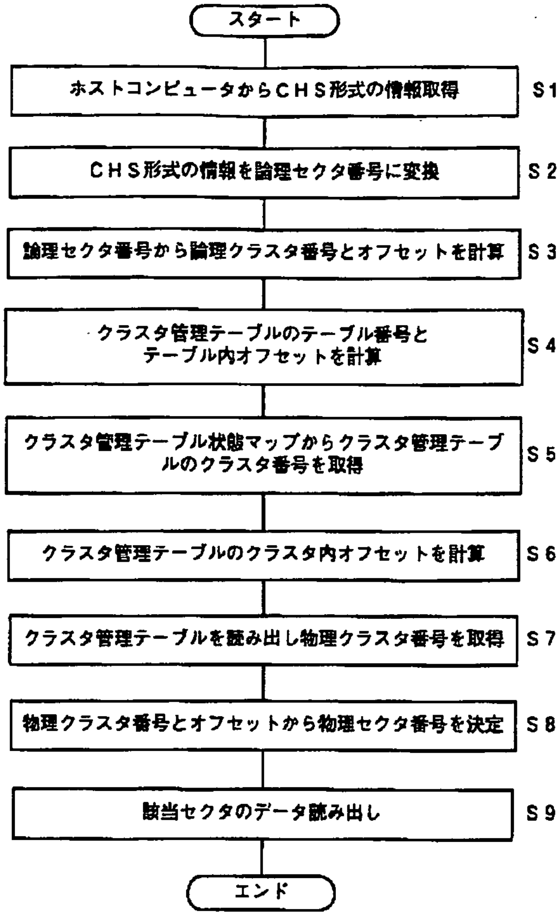
(a) クラスタ管理テーブル (b) テーブル0

[Drawing 5]

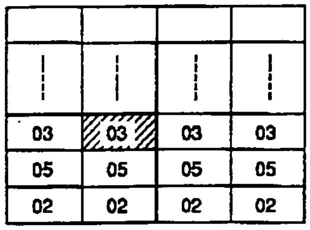


(a) クラスタ管理テーブル (b) クラスタ管理テーブル状態マップ

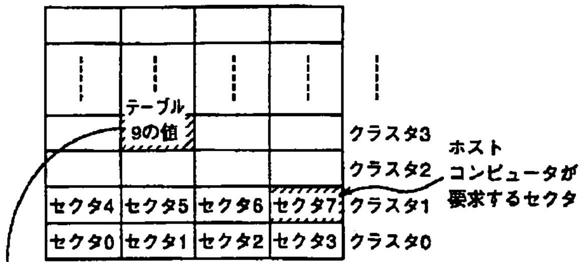
[Drawing 6]


スタート
ホストコンピュータからＣＨＳ形式の情報取得
S1
ＣＨＳ形式の情報を論理セクタ番号に変換
S2
論理セクタ番号から論理クラスタ番号とオフセットを計算
S3
クラスタ管理テーブルのテーブル番号と
テーブル内オフセットを計算
S4
クラスタ管理テーブル状態マップからクラスタ管理テーブ
ルのクラスタ番号を取得
S5
クラスタ管理テーブルのクラスタ内オフセットを計算
S6
クラスタ管理テーブルを読み出し物理クラスタ番号を取得
S7
物理クラスタ番号とオフセットから物理セクタ番号を決定
S8
該当セクタのデータ読み出し
S9
エンド

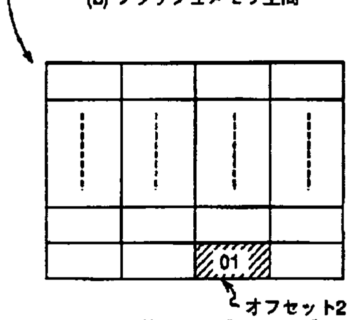
[Drawing 7]



(a) クラスタ管理テーブル状態マップ

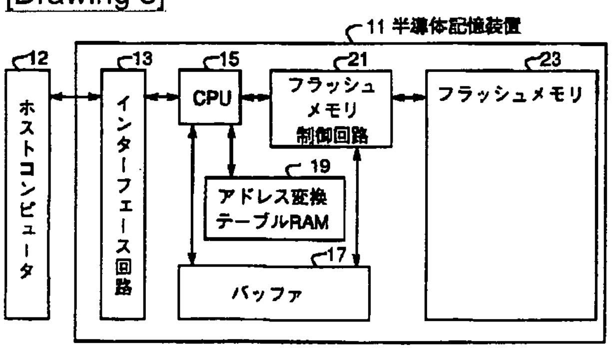


(b) フラッシュメモリ空間



(c) クラスタ管理テーブル (テーブル9)

[Drawing 8]



[Translation done.]

WRITTEN AMENDMENT

-- [Written amendment]
[Filing date]November 7, Heisei 8
[Amendment 1]
[Document to be Amended]Specification
[Item(s) to be Amended]0003
[Method of Amendment]Change
[Proposed Amendment]
[0003]When rewriting the data in a flash memory, it is necessary to rewrite the whole erase blocks in which the data is contained. For example, in the case where 512 bytes of data is rewritten. After once evacuating the data in tens of [several to] K bytes in which 512 bytes of the data is contained of erase blocks to another field and eliminating the block, it is necessary to write in new data with the data evacuated to the block. For this reason, there was a problem that writing efficiency was bad. In a flash memory, since a number of erase times had a maximum, when writing concentrated on specific erase blocks, there was a problem of having exceeded the full limits of a number of erase times, and becoming unusable for a short period of time.

[Translation done.]